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PARAONIS PYGOENIGMATICA NEW SPECIES, A NEW ANNELID FROM MASSACHUSETTS (POLYCHAETA: PARAONIDAE)

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In his comprehensive study of the Paraonidae, in general, and of *Aricidea jeffreysii* (McIntosh), in particular, Cerruti (1909) synonymized *Levensenia* Mésnil, 1897, with *Paraonis* Grube, 1873, and recognized the latter and *Aricidea* Webster, 1879, as the two valid genera of the family. In addition, he reduced *Cirrophorus* Ehlers, 1908, to subgeneric status in the genus *Aricidea* and proposed a new subgenus, *Paraonides,* for the genus *Paraonis.*

This classification of the Paraonidae was followed for more than fifty years, and was recognized by Fauvel (1927), E. and C. Berkeley (1956), Hartman (1959), Day (1961), and Pettibone (1963). Hartman (1957), in addition to proposing a third subgenus, *Aedicira,* for the genus *Aricidea,* redefined *Paraonis* (*Paraonides*) Cerruti.

It remained for Day (1963) to raise the subgenera to generic rank with the statement (p. 420) that ". . . as the whole family includes some fifty species it is suggested that the subgenera be given full generic rank." Hartman (1965a), with some few exceptions, concurred with Day as to the generic status of the former subgenera and proposed two new genera, *Aparaonis* and *Paradoneis,* the latter including *Paraonides* as earlier redefined (Hartman, 1957); all seven genera were listed in Hartman's catalogue supplement (Hartman, 1965b). Laubier (1965, p. 469), in his report of the presence of *Cirrophorus* in the Mediterranean, followed Day in the recognition of genera, with the comment that "Ce point de vue parait

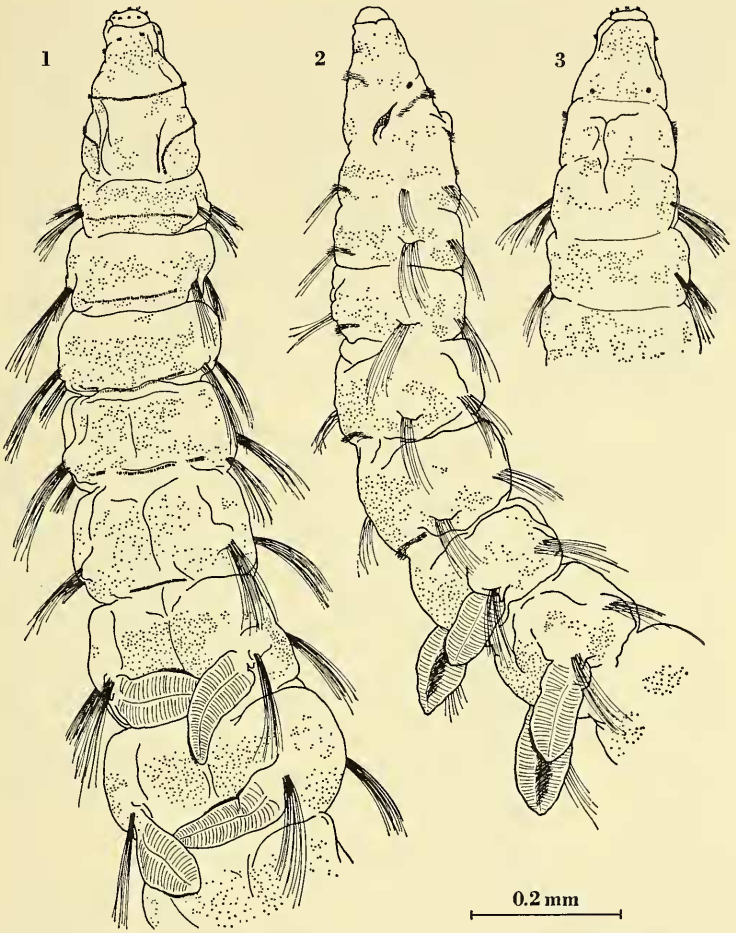
justifié . . . ," and Glémarec (1966), in describing a new species of *Paradoneis* from Brittany also accepted Day's judgment. Finally, Day (1967) continued the recognition of the former subgenera as genera, with the exception of *Paradoneis* Hartman which he returned to *Paraonides* Cerruti. Thus, according to some authors there are presently seven, six, or two genera in the family Paraonidae, and generic criteria are the presence or absence of modified setae in neuropodia or notopodia and/or the presence or absence of a median prostomial antenna.

It was on the basis of the above that at the outset of the present study, when a paraonid species was found which possessed modified setae in *both* neuropodia *and* notopodia, it was felt that this represented a new genus. However, a survey of the literature has presented a number of questions which have made this decision less straight-forward than originally thought.

Paradoneis Hartman has been taken to include *Paradoneis lyra* (Hartman, 1965) with modified setae comprised only of lyrate notosetae while *Paradoneis armata* (Glémarec, 1966) has modified setae represented by notopodial lyrate *and* acicular aristate forms and *Paraonis* (*Paraonides*) *harpagonea* (Störch, 1967) has lyrate setae of two types, as well as bidentate hooks, as modified setal types. In addition, *Paraonis* (*Paraonides*) *neapolitana* (Cerruti, 1909) is said to have broadly limbate setae as modified setae; this would hardly be considered "modified" in the same sense as lyrate or acicular aristate setae.

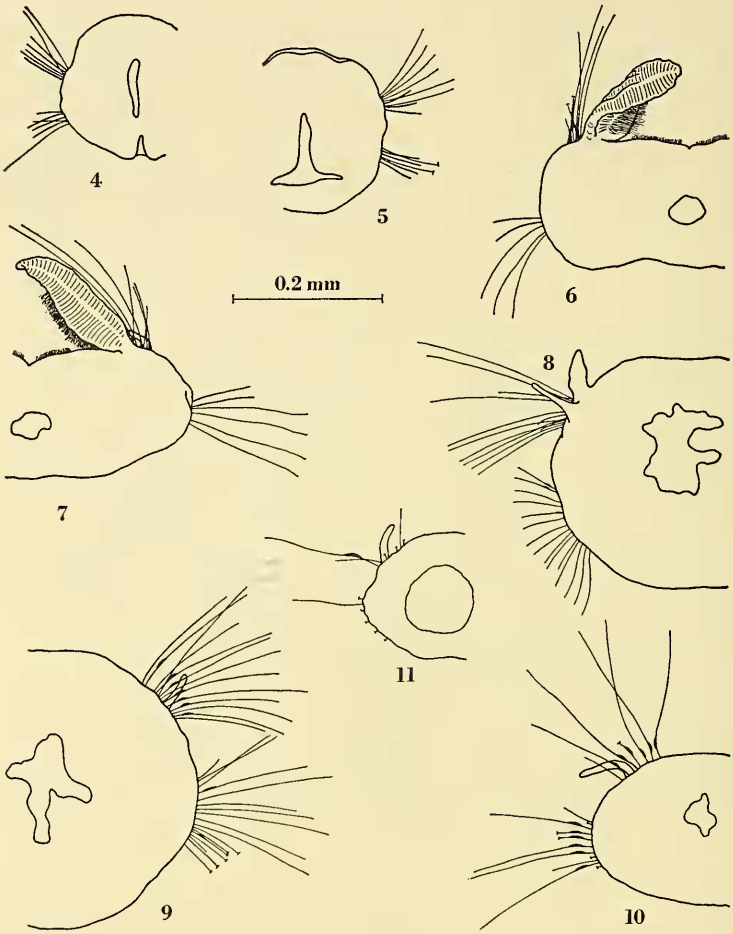
Further, *Paraonis platybranchia* (Hartman, 1961) is said to lack modified setae in either neuropodia or notopodia, and would appear to be a species of *Aparaonis* (Hartman, 1965) which, according to both a key to genera and the generic diagnosis, has only "pointed" setae in neuropodia and notopodia. However, a figure of a parapodium of *Aparaonis* reveals neuropodial acicular spines, also referred to in the description, which may represent modified setae and, thus, suggest that *Aparaonis* should be synonymized with *Paraonis*.

In considering paraonids with a medial prostomial antenna, *Aricidea* (*Aedicira*) (Hartman, 1957) was said to have no



FIGURES 1–3. *Paraonis pygoenigmatica* new species. 1, Dorsal view of anterior region. 2, Lateral view of right side of anterior region. 3, Ventral view of anterior region.

modified setae, although a figure of the type species (*Aricidea pacifica* Hartman, 1944, Fig. 9) suggests that a second type of seta, perhaps "modified," is present. Hartmann-Schröder (1962) has described a species of *Aricidea* (*Aedicira*) which possesses acicular (modified ?) neurosetae. Finally, there would appear to be at least three types of "modified" setae



FIGURES 4–11. *Paraonis pygoenigmatica* new species. 4, Right first setiger, anterior view. 5, Right second setiger, posterior view. 6, Right sixth setiger (first branchial), anterior view. 7, Left sixteenth setiger, anterior view. 8, Left twenty-second setiger (last branchial), posterior view. 9, Left twenty-third setiger (first postbranchial), anterior view. 10, Right forty-first setiger, anterier view. 11, Right fifty-ninth setiger (fourth to last), anterior view. Lumen of gut is indicated in all figures; setae with swellings near proximal ends are specialized; setae drawn with T-shaped tips represent broken setae.

described for various species of *Aricidea* Webster (abruptly attenuated, pseudoarticulate, acicular, and acicular with mucronate tips) and for *Cirrophorus* Ehlers (acicular, with a frail sheath, or acicular aristate).

In view of the discussion above it was considered prudent to be taxonomically conservative in the present case and to beg the question of the validity of genera and subgenera. For, until a critical comparison and an evaluation of the taxonomic value of the so-called modified setae can be carried out, I prefer to consider that there are two genera, *Paraonis* and *Aricidea*, which comprise the Paraonidae and that there is too much confusion in the literature to allow the definition of subgenera.

The present study was prompted by my attention being drawn to a collection of paraonids taken in the course of the Cape Cod Bay Census by personnel of the Systematics-Ecology Program (= SEP), Marine Biological Laboratory, Woods Hole, Massachusetts. I am indebted to these individuals, Dr. David C. Grant, Resident Biologist, and Dr. Melbourne R. Carricker, Director, for allowing me the opportunity of observing this material and for the gift of a part of their material to the collections of the United States National Museum. I am further grateful to Dr. Marian H. Pettibone and Nancy M. Cramer, both of the Division of Worms, for their criticisms and comments on this work.

Paraonis pygoenigmatica new species

Differential Diagnosis: *Paraonis* with limbate and non-limbate capillary setae in the anterior region; with laneolate branchiae beginning on the sixth setiger and extending to the 20th to 25th setiger; with setae provided with a sub-basal tooth present in neuropodia and notopodia of the posterior branchial region continuing to the posterior end of the body; with postsetal notopodial lobes beginning on the sixth (= first branchial) setiger; with no postsetal neuropodial lobes; pygidium with from three to eight anal cirri.

Type Locality: The collection upon which the present research is based is comprised of 61 specimens. The holotype (USNM 37457) and paratypes (USNM 37458) were collected at SEP station 1910-E3 in Cape Cod Bay (lat. 41° 48.7′ N; long. 70° 04.6′ W), 17 May 1967, in hard-packed sand, at a depth of approximately seven meters (50 specimens). Other paratypes were collected at SEP stations 1930-E2 (lat.

41° 50.0′ N; 70° 30.4′ W, 21 November 1967, eleven meters, nine specimens), 1030-E (lat. 41° 49.0′ N; long. 70° 30.4′ W, 21 November 1967, thirteen meters, one specimen), and 1608-E3 (lat. 41° 51.9′ N; long. 70° 01.8′ W, 6 September 1967, six meters, one specimen). Paratypes not deposited in the collections of the U. S. National Museum have been returned to the reference collection of the Systematics-Ecology Program, Marine Biological Laboratory, Woods Hole.

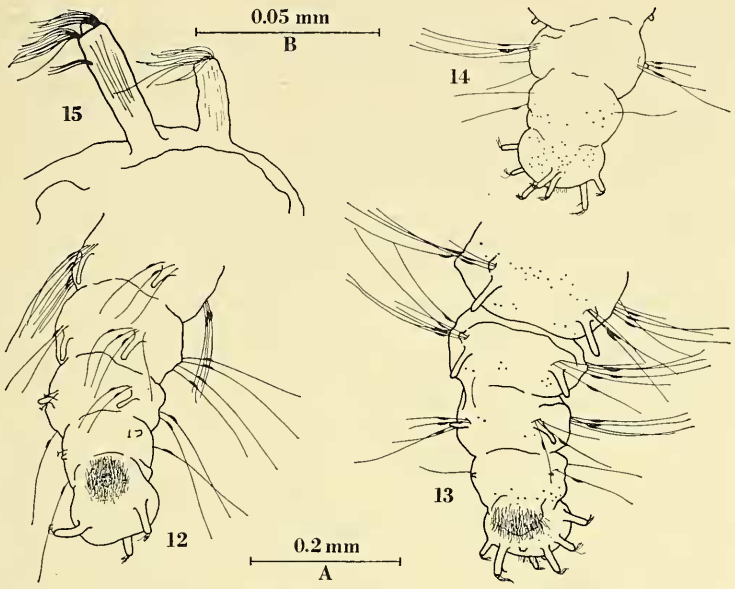
Description: Complete representative specimens vary from 0.25 to 0.33 mm in diameter, at the widest part of the anterior region, and are 18 mm (for 77 setigerous segments, 16 mm (81 setigers), 13 mm (79 setigers), 12 mm (71 setigers), and 9 mm in length (for 62 setigers). One ovigerous specimen, incomplete posteriorly, is 7 mm long (for 62 setigers) and 0.25 mm at its widest.

The generally brownish appearance of specimens preserved in alcohol is due to the presence of small pigment granules, most dense on the dorsal surface, and least dense on the ventral surface. There is a basic segmental distribution of the pigment granules, in that there appear to be few, if any, present in the intersegmental regions.

The prostomium is conical and poorly delimited from the peristomium (Figs. 1–3). The anterior area of the prostomium appears to be set off from the basal part by a deep transverse furrow. This buttonlike prostomial tip appears to be retractile into a subapical pocket formed by the adjoining surface of the prostomium; the margin of this pocket is smooth, except for a pair of very small lateral notches (Fig. 2). A pair of darkly pigmented eyespots are embedded ventrolaterally in the posterior region of the prostomium. The peristomium is achaetous and is provided with a pair of dorsolateral nuchal slits. As mentioned above, the peristomium is not sharply set off from the prostomium; indeed, there is only a rather faint ventrolateral segmental furrow separating the two. The mouth is "T"-shaped and opens in the anterior third of the peristomium (Fig. 3); a medial furrow runs posteriorly to the first setiger.

The prebranchial region is comprised of five setigerous segments and is circular in cross-section (Figs. 4 and 5). There are no cirri or any other parapodial appendages present in this region. The branchial region extends from the 6th (Fig. 6) to the 20th to 24th setiger (Fig. 8); it is flattened dorsoventrally anteriorly and grades to a more circular cross-section posteriorly (Figs. 6–8). In addition to paired branchiae, each setiger bears a pair of cirriform postsetal notopodial lobes. The postbranchial region is comprised of from 40 to 50 setigers which are circular to subcircular in cross-section (Figs. 9–11) and segmentally constricted to give the posterior body a somewhat moniliform aspect; each setiger bears a pair of postsetal notopodial lobes. The length to width ratio of the prebranchial segments is approximately 1 : 2, that of the branchial segments is approximately 1 : 4, and the ratio for the postbranchial segments varies from 1 : 3 in the region immediately following the branchial area to approximately 1 : 1 in the posterior portion.

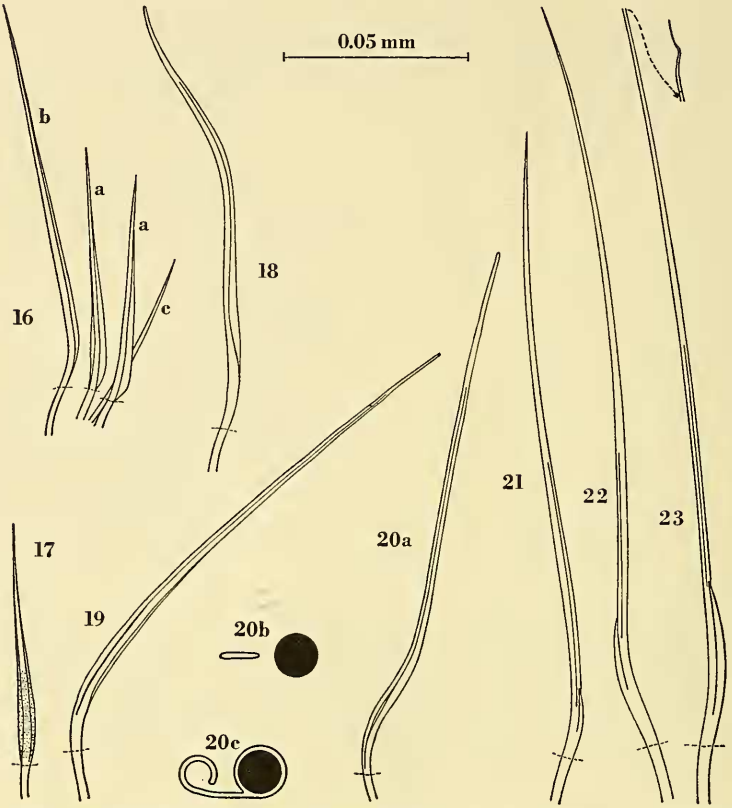
The pygidium is rounded and bears a heavily ciliated, dorsally placed



FIGURES 12–15. *Paraonis pygoenigmatica* new species. 12, Dorsolateral view of pygidium and last four setigers of a specimen with usual complement and disposition of three anal cirri. 13, Dorsal view of pygidium and last four setigers of a specimen with supernumerary anal cirri. 14, Ventral view of pygidium of same. 15, View of two anal cirri showing pattern of ciliation. Figs. 12–14, scale A; Fig. 15, scale B.

subterminal anal opening. In addition, there are usually three anal cirri, a pair dorsolaterally and a single one ventromedially (Fig. 12). However, there may be as many as four pairs of anal cirri disposed over the surface of the extreme posterior face of the pygidium (Figs. 13 and 14); the most medial pair are ventrally placed and the most lateral are at about the level of the anal opening. The tips of the anal cirri are provided with extensible, possibly articulated, apical processes (Fig. 15). The distal portions of the anal cirri also bear tufts of cilia (Figs. 12–15) which suggest the presence of sense organs.

The branchiae are lanceolate and of approximately the same size (Figs. 1, 2, 6, and 7), except for the much smaller posterior-most pair (Fig. 8). The branchiae are oriented in a parasagittal plane and each bears a central medial ciliated tract. Both the medial and the lateral surfaces of the branchiae have a barred appearance due either to parallel wrinklings of the surface or to a well-ordered distribution of the cellular elements comprising the tissue of the branchiae.



FIGURES 16–23. *Paraonis pygoenigmatica* new species. 16, Three types of neurosetae of the first setiger. 17, Notoseta (type 1) of the first setiger showing extent of granular surface of sheath-like structure. 18, Notoseta from second setiger. 19, Neuroseta from sixth setiger with presumed separation indicated by heavy-line. 20, Neuroseta from sixth setiger showing (a) basal separation between sheath or limbation and axis, (b) hypothetical cross-section of separation area if there is an actual separation, (c) hypothetical cross-section if the sheath or limbation is rolled. 21, Specialized notoseta from twenty-second setiger. 22, Specialized neuroseta from forty-first setiger. 23, Specialized notoseta from fifty-ninth setiger.

There is a rather extensive pattern of ciliation present in the anterior region. The prostomial tip, as well as the main portion of the anterior region of the prostomium, is strewn with a number of ciliated tufts (Figs. 1 and 3) which probably represent sensory structures. In addition

there are dorsal, transverse ciliated bands present on the prostomium and at the posterior margin of each of the prebranchial setigers (Figs. 1 and 3) and between the branchiae of the following region (Figs. 6 and 7). The peristomium bears a pair of oblique, lateral, ciliated bands which are associated with the nuchal slits at their dorsal ends. The main function of these bands, in conjunction with branchial cilia, is probably concerned with the maintenance of respiratory water currents.

The setae are arranged in fascicles which are not obviously palisaded and which are located from the middle to the posterior third of a given segment. The setae in both the neuropodia and notopodia of the first setiger are of three kinds: (1) short capillary setae, broadly uni- or bilimbate, which are disposed in an anterior series (Fig. 16, *a*), (2) long, narrowly unilimbate capillary setae (Fig. 16, *b*) which, along with (3) short non-limbate capillary setae (Fig. 16, *c*), are arranged in a posterior series. It will be noted that types (1) and (2) have been referred to as "limbate"; observations under oil-immersion suggest that the structures which give the impression of being flattened, typical limbations when examined with lower magnifications, may actually be sheath-like structures, not unlike the hoods of some hooded hooks of other families, *e.g.*, the Spionidae and Magelonidae. Such has also been observed to be the case when structures appearing to be limbate capillary setae of certain spionid polychaetes were carefully observed with oil-immersion optics. In addition, the limbation or sheath may present a granular appearance (Fig. 17) suggestive of a finely spinous surface (cf. Jones, 1962, Figures 73–76, Fauvel, 1927, Figures 12, *m* and *n*; Figure 14, *i*, and Mésnil, 1896, Plate 7, Figure 12, Plate 9, Figures 7 and 13, *et seq.*).

Capillary setae of all three types mentioned above are present on all of the remaining prebranchial setigers, although the setae of type (2) may become less typical (Fig. 18) with a less readily distinguishable axis and a less distinct axial termination, giving the impression of an extension of the "limbation" beyond the setal axis (Figs. 17, *et seq.*).

All three types of capillary setae are present in the anterior portion of the branchial region. However, there is a progressive decrease in the number of the setae of type (1) along the length, until these are confined to the neuropodial fascicle by the 16th setiger and are lacking altogether by the last branchial setiger. In the branchial region there may be a further modification of the setae of type (2). At times there may be a discrete separation between the "limbation" and the axis (Fig. 19) and this may be so pronounced as to give the appearance of a slit (Figs. 20a and b); it is difficult to ascertain the nature of this structure with certainty and it may be that this is not in fact a slit but a space between the axis of the setae and a rolled portion of the sheath or limbation (Fig. 20c).

In the posterior branchial region there are no setae of type (1) and setae of a fourth type are present. These appear to be derived from the modified setae of type (2) (Figs. 19 and 20) and bear a "limbation" as

well as a closely applied basal tooth (Figs. 21–23). More posteriorly these toothed setae come to be the dominant setal type, until in the pygidial region they are nearly the only type present in both neuropodia and notopodia (Figs. 8–14). In addition to the increased numbers of these setae toward the posterior region, there is also an increase in the relative length of the basal tooth; in the last branchial setiger the ratio of the tooth length to the total length is approximately 1 : 13, further posterior, 1 : 8, and in the extreme posterior region, 1 : 4 or 1 : 5. Shortly after the appearance of the first of these toothed setae in the branchial region, they are to be found in both notopodia and neuropodia, where they continue to be present to the end of the body (Figs. 9–14). These are taken to represent the so-called "modified" or "specialized" posterior setae of other paraonids.

Etymology: The specific epithet refers to the occurrence of pygidia with supernumerary anal cirri; this condition is truly enigmatic.

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